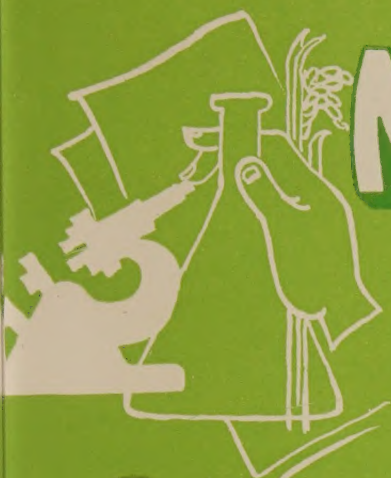


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NUTRITIVE VALUE OF HIGH PROTEIN RICE INDUCED BY NITROGEN FERTILIZATION

M.C. Kik and Vernon L. Hall¹

In previous greenhouse studies (1,2) with single applications of nitrogen fertilizer to rice, it appeared that seed yield increased when the nitrogen application was made during the development of the reproductive cycle of the plant. It was also found (2) that the application of nitrogen to the rice plant just before head emergence increased the protein content of the paddy rice.

In this study two samples of seed were obtained from Bluebonnet 50, a long grain variety, grown and fertilized in the greenhouse. One sample was obtained from plants that were fertilized for maximum seed production and the second from plants fertilized to increase the protein content of the seed.

Plants under the maximum yield treatment produced 14.71 grams of oven-dried seed and 1.23 grams of protein per container. This seed had a protein content of 8.38 percent. The plants that were fertilized to produce high protein seed gave 11.12 grams of oven-dried seed and 1.20 gram protein per container. This seed had a protein content of 10.76 percent.

Both samples of seed were analysed

to determine their relative nutritional value as whole brown rice. Microbiological assays were made for nutritionally essential and non-essential amino acids.

The assay of the seed in terms of the percentage of nutrient in the dry matter and the total weight of nutrient produced is reported in Table 1. The percent of each nutrient increased with the increase in protein content of the seed but quantitatively the amount of each nutrient produced was associated with the maximum yield treatment.

This study revealed that the proper timing of a nitrogen fertilizer will increase both the percentage of protein and of each of the amino acids in the rice grain. The protein-nutrient ratio was more nearly balanced when the rice plant is fertilized for maximum seed production than when it is fertilized to obtain a high protein content in the grain.

The chemical analysis showed both samples of rice to be very low in the essential amino acid tryptophan and that the tryptophan content was not appreciably increased when the rice plant was fertilized to increase the protein content of the seed.

¹ Dr. Kik is an agricultural chemist and Mr. Hall is an assistant agronomist with the University of Arkansas, Fayetteville, Arkansas, United States of America.

TABLE 1

*Amino Acid Content of Regular and High Protein Whole Rice,
Bluebonnet 50 Variety*

Amino Acids	Regular Protein Rice (8.38% Protein)		High Protein Rice (10.76% Protein)	
	Oven-dried	Total weight	Oven-dried	Total weight
	seed	produced	seed	produced
	Percent	Milligrams	Percent	Milligrams
Alanine	0.520	7.63	0.618	6.89
Arginine*	0.570	8.36	0.578	6.44
Aspartic acid	0.700	10.27	0.730	8.14
Cystine	0.150	2.20	0.160	1.79
Glutamic acid	1.100	16.15	1.380	15.40
Glycine	0.500	7.34	0.550	6.13
Histidine*	0.270	3.96	0.300	3.35
Isoleucine*	0.380	5.57	0.410	4.57
Leucine*	0.620	9.10	0.720	8.03
Lysine*	0.230	3.37	0.240	2.68
Methionine*	0.220	3.22	0.270	3.01
Phenylalanine*	0.470	6.90	0.570	6.36
Proline	0.440	6.46	0.470	5.24
Serine	0.300	4.40	0.330	3.68
Threonine*	0.400	5.87	0.420	4.68
Tryptophan*	0.070	1.03	0.090	1.01
Tyrosine	0.360	5.29	0.410	4.57
Valine*	0.520	7.64	0.550	6.13

* Nutritionally essential

References

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A NOTE ON CULTIVATION OF MILK FISH (CHANOS CHANOS) IN RICE FIELDS IN THAILAND

J.A. Tubb¹

During the past two years attempts have been made in Thailand to develop a system of rice plus milk fish culture in some of the rice growing areas, South and East of Bangkok. The collection of milk fish fry is adequate to sustain a useful industry and it is anticipated that production can be increased quite appreciably during the next 3-4 years.

To study this type of culture, a small rice farm at Song Klong Village, 63 km. from Bangkok in the Banpatong District was selected.

It was reported that during April and May the water in the rice fields was comparatively saline and that no cultivation took place. In June following the early rains and the diminution in salinity of the water in the rice fields, the fields were prepared for the next crop.

Chanos fry captured along the coast during April and May were held in high concentration in nursery ponds adjoining the rice fields, and in July they were released by opening the bund of the nursery pond, allowing the fish to disperse throughout the cultivated field.

In the paddy field examined, the area was approximately 3.2 ha. in which were introduced the survivors from 30,000 *Chanos* fry. The fry were estimated at this number when introduced into the nursery ponds but no count was made of

the fish escaping from the nursery pond into the rice fields. Extending along one side of the rice field was a ditch about 3 m. wide and 1 m. deep and from this lateral channels crossed the field dividing it into blocks of about 0.8 ha.

The rice seedlings were set out in August and the water level was maintained at about 20 cm. increasing to 30 cm. as the seedlings grew. The rice had matured and harvesting was almost complete at the time of the visit (9 December 1960). The farmer estimated that the field would yield approximately 2600 kg. of rice per ha. This was in comparison with the normal yield of this field, while the anticipated yield of an adjoining field, in which no fish were used, was 1950 kg/ha.

Inspection of the rice indicated that not only growth and maturing were more rapid but that tillering also was greater. The rice stools were clean and free from algae and the farmer reported that during the early growth of the rice, the field containing fish required much less weeding than the fields without fish (this may be—partly at least—due to the depth of water in the flooded rice field). The rice in the adjoining field without fish required another two weeks to maturing.

When harvesting the rice, the water in the field was lowered to approximately

¹ Regional Fisheries Officer, FAO Regional Office, Bangkok.

10-15 cm. and the rice heads cut, bundled and stacked in boats. The fish in the meantime moved into the main ditch and lateral trenches. By inspection, the fish appeared to be present in large number and from 12-18 cm. in length. After the rice harvest, the water level in the field would be raised another 30 cm. to let the fish remain until the following May before harvesting. The farmer stated that he did not think there would be sufficient food in the field after the rice had been removed and he intended to feed the fish with rice bran, giving about 2 kg. per ha. daily. During the growing season for both

fish and rice, small quantities of fertilizer in the form of chicken manure were spread.

It was reported that in addition to *Anabas* and *Ophicephalus* a good stock of *Tilapia* was also present. The *Tilapia* were regularly harvested in small numbers by mesh nets and provided sufficient fish for 3 households throughout the major part of the year. The farmer also had another field of 1.6 ha. area in which 10,000 *Chanos* fry had been released from an adjoining nursery pond. The system of operation for the smaller field was the same as for the one described above.

SPRINKLER IRRIGATION-TYPES AND POSSIBILITIES¹

B.K. Bhattacharjee² and Everett H. Davis³

Introduction

Moisture at the right time and in the right amount makes an important difference in the quality and production of crops. Irrigation is successful only if it produces a profit for the cultivator. It is important that the correct types of irrigation scheme be designed for the particular local conditions. The water supply, drainage, labor, soil fertility and insects and diseases—all should be considered in the overall irrigation scheme.

A common mistake in planning irrigation is to attempt to irrigate too much land with too little water. The water supply must be adequate to last through a prolonged dry spell. There is no point in irrigating a large acreage half way through a drought and then allowing the crop to be damaged and yields reduced because of a water shortage. The cultivator gets his biggest returns from irrigation during the *dry periods* and so we should help him plan his irrigation scheme to meet those needs.

The three most likely sources of irrigation water are underground supplies pumped from wells or pits, flowing streams and surface (storage tanks and reservoirs). Irrigation requires labor. The labor must be trained to handle irrigation as otherwise crop damage and wastage of water will result. One advantage of sprinkler irrigation is that

unskilled (untrained) labor can be employed. Good drainage is essential. Land that is poorly drained cannot be successfully irrigated until a surface drainage system or tile system, or both are installed.

The best returns are obtained with irrigation on land that has a high level of fertility and that has received soil treatments. The treatments will include liberal fertilisation and proper crop rotations. Good soil management will reduce leaching of fertilizer elements, furnish organic matter and make the soil easy to till.

Irrigation water can make conditions ideal for attack by insects and diseases, just as it can be helpful to crops. Both insects and diseases can be controlled by using good cultural practices and by following a good spray program.

Why Sprinkler Irrigation

The authors quite realize the relative cost of using sprinkler irrigation and they feel that this system of irrigation will have very limited use in India for the present. However, they also realize the importance of this system under certain conditions. In sandy tracts high seepage losses occur in surface irrigation and consequently smaller acreages are commanded by an individual irrigation

- 1 Paper read at the Agricultural Engineering Symposium, Indian Institute of Technology, Kharagpur, October 15 & 16, 1960.
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source. The authors in course of their irrigation experiments at Kalyani State Farm, W. Bengal, where the soil is riverine sandy soil with shallow depth of only 6" or so, have experienced that the percolation loss is very high when surface irrigation is employed and the irrigation requirement of water consequently becomes too great. On the other hand, the 10" tubewell from which the irrigation water is drawn can command much lesser area than the same size tubewell in other soil tracts. But with sprinkler irrigation it was found that considerable water economy results. Then again sprinklers have been found to be successful in irrigating undulating and uneven lands, levelling of which would mean considerable expense.

In order to find out answers to the above problems, the authors took up the work of designing one sprinkler irrigation set which would be cheaper and efficient for the conditions in India. Commercial sprinkler sets are available in the market but they are prohibitive in cost, average price of a set being approximately Rs. 1,050.00 (US\$220.00) for 300 feet of two-inch pipe. It is estimated that the present design would cost approximately Rs. 300.00 (US\$63.00) for 300 feet of two-inch pipe when produced commercially and is operated by ordinary 5 h.p. pumping set, with quick detachable couplings and locally rolled thinner gage perforated pipes.

How Sprinkler Irrigation Works

Sprinkler and surface irrigation schemes require plentiful and reliable sources of water and must provide conveyance to the land and means of distributing water over the soil.

Sprinkler irrigation methods employ pressure to convey water through pipe lines and operate devices for distributing water on the soil in the form of gentle rain. Water pressure is ordinarily provided by pumps but frequently the water source is at a level high enough to provide the necessary pressure. This would be true in the rolling hill country of India, especially for irrigating orchards and vegetable plots in the northern Himalayan regions such as Darjeeling districts.

Water is conveyed from the pump to the field in what is commonly called main-line pipe. A sprinkler pipe line is then attached to the main line at right angles and laid across the field to be irrigated. Detachable couplings make it possible to move the sprinkler pipe line from one position to another to cover the whole area to be irrigated.

Perforated pipe and revolving sprinkler systems are the common types. There are many variations of the revolving sprinkler schemes ranging from sprinkler heads that discharge from $\frac{1}{2}$ gallon per minute to the giant ones which deliver over 600 gallons per minute. Incidentally, this big sprinkler would handle the total discharge of many of the deep tube wells in West Bengal.

The perforated pipe sprinkler systems is discussed in more detail in this paper. This system eliminates the need of revolving sprinkler heads since water is sprayed from the pipe by means of small holes drilled in a predetermined pattern. The authors first considered the possibility of using the thin wall type of bamboo as pipe since it is available in most parts of India at low cost.

Thin wall type of bamboo is under test at Birla College of Agriculture for use as perforated pipe sprinkler system. The partitions (nodes) in the bamboo can sometimes be broken out with a strong pole. A hot iron can also be used to burn out the partition at the nodes. Small holes are drilled in the bamboo pipe in a predetermined pattern to give proper distribution of water. It was soon discovered that a metal processing plant north of Calcutta was equipped to roll pipe out of light gage galvanised sheet metal at a price competitive with bamboo. Some field tests have been made which has encouraged the authors to continue the work further. The pipe is coupled together with rubber hose pipe and clamps thus making an inexpensive coupling device.

One of the factors in designing sprinkler systems is to provide a coupling device that permits lengths of pipe to be moved from one setting to another in the field. Since perforated pipe systems operate satisfactorily at low pressures the authors have learned that an inexpensive coupling can be made of rubber hose pipe and clamps similar to that used on water circulating systems on automobiles. Water can be sprayed a total distance of 25 to 30 feet at pressures less than 10 pounds per square inch. The amount of water applied on the land can be controlled by the size of holes drilled in the pipe, their spacing, and the pressure in the system. Experiments are in progress to determine the correct size of holes and spacings to get a required amount of water. A chart prepared showing amount of water obtainable with different sizes and spacings of holes will enable one to quickly choose

the sprinkler set required for his specific purpose.

Two-inch sheet metal pipe with the hose couplings cost approximately Rs. 1.00 per foot. Further tests will be made on 3 and 4-inch pipe.

Advantages of the Perforated Pipe Sprinkler System

1. Low in first cost. No separate sprinkler heads are required.
2. Adapted to sandy soils where percolation water losses would be high with surface methods.
3. Adapted to uneven land where top soil is too shallow to permit levelling for surface irrigation.
4. Seed germination is faster and better. Surface irrigation often floats seed to low end of field.
5. No land is taken out of production for irrigation ditches.
6. Unskilled labor can irrigate with this sprinkler system.
7. More uniform distribution of water. More land can be irrigated therefore with a limited water supply. Sprinkler systems often used 25 to 50 per cent less water than surface methods. Trials have been laid out to determine the water economy resulting from sprinkler irrigation compared to that of surface irrigation in irrigating a crop of rice, wheat and potato in the sandy soil tracts.

Operation of Sprinkler System

Light weight pumping units can be used on the smaller acreages. Small capacity pumps can be used on shallow tube wells in many areas. Excess water from irrigated land or water accumulated in

low areas during monsoons can be pumped and re-used in irrigation schemes. Of course, electric power is not yet readily available in the rural areas of India. Powerine, petrol and diesel engines can be used for operating centrifugal pumps to deliver water from shallow tube wells or reservoirs. Electric motors can be directly connected to centrifugal pumps to operate sprinkler systems. A wide range of pressures and capacities are available in centrifugal pumps.

Aluminum pipe lines with revolving sprinklers attached are used to irrigate high income crops. Pipe made of aluminium is coupled and uncoupled by hand labor in most instances. Thirty to forty foot lengths of aluminium pipe are easily carried by hand.

Low-angle sprinklers are designed for orchard irrigation. There are also the giant sprinklers in operation. It covers

one acre and can deliver up to 600 gallons per minute. The entire sprinkler line up to 1,500 feet long can be pulled by tractor from one position to another. Pipe is mounted on wheels which are 40 feet apart. Rubber valves in pipe automatically let out water when pressure is turned off so that the line is empty when moved.

Sprinkler lines sometimes are attached to large wheels rigidly attached to the pipe. Entire line up to 1,500 feet long is rolled across the field from one setting to another. An engine drives a mechanism to roll the pipe. A hand ratchet can also be used to move the pipe line where hand labor is employed.

Self-propelled power and pump units move along an irrigation ditch and spray water on both sides with sprinklers attached to long boom pipes which are suspended in the air and attached to the pump.

Performance Chart of Perforated Pipe

Spread in ft.	Pressure & Volume	Length of drilled pipe line in feet													
		2-inch pipe					3-inch pipe				4-inch pipe				
		50	100	150	200	250	250	300	350	400	400	450	500	550	
30	P	11	11	12	12	14	11	12	12	13	11	11	12	12	
	GPM	11	21	31	42	54	51	62	73	84	83	93	104	113	
28	P	10	10	11	11	13	10	11	11	11	10	10	11	11	
	GPM	10	19	30	40	52	48	59	69	80	79	89	99	109	
26	P	8	8	8	9	10	8	8	9	9	8	8	9	9	
	GPM	9	17	26	35	47	44	53	62	71	70	79	88	97	
24	P	7	7	7	8	9	7	7	8	8	7	7	8	8	
	GPM	9	16	25	33	44	41	50	58	67	65	74	82	90	

P = Pressure in lbs. per square inch

GPM = Imperial Gallons per minute

Area irrigated = spread in feet times the length of drilled pipe

A NOTE ON A GALL MIDGE RESISTANT RICE VARIETY IN THAILAND

S.H. Ou¹ and Prakob Kanjanasoon²

The gall midge, *Pachydiplosis oryzae*, has been one of the most serious pests on rice in Northern Thailand. The infestation has been particularly heavy in the hilly provinces such as Chiangrai, Lampang, Prae and Nan but the insect may also be found in nearby localities. An estimate of the loss, varying somewhat each year, is 50% of the total rice production in the area. The total infested area is estimated at not less than 1,500,000 rai (1 rai = app. 1/6 hectare).

The insects attack the growing points of tillers of varying ages and long, narrow tubular galls are produced. The infested tillers cease to grow normally and eventually die. Young tillers are attacked consecutively and at the end of the season only very few poor heads are produced.

An experiment conducted in 1960 for assessing the loss from insects and diseases in a farmer's field showed that 3 applications of pesticides (the insecticide malathion and the copper fungicide

Cuprivet) during the growing season increased the yield approximately 100% in each of the 3 replications. The main reason for the increases was the control of the gall midge.

The development of the insect in 1960 was very abundant. In demonstration plots for the control of the elongation disease (*Gibberella fujikuroi*) by seed-treatment in the North, several local varieties were used including a glutinous rice variety called Muey Nawang which was used in Lampang Province. This variety was found to be highly resistant to gall midge. While all the neighbouring fields suffered more than 80% loss, this variety was almost free from infestation by the insect. The farmers do not like this variety much because of the difficulty in threshing and also because of its lodging habit. However, it should be very useful as breeding material for introducing gall midge resistance in commercial varieties.

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FERTILIZER TRIALS ON PADDY IN FARMERS' FIELDS IN EAST PAKISTAN

M.A. Islam¹

Introduction

Simple fertilizer experiments in farmers' fields were started in East Pakistan in August, 1957. Since then 3371 experiments have been conducted on rice as well as experiments on wheat, sugarcane, potato, mustard, etc. The results of experiments on rice crops from 1957 to 1960 are presented and discussed in this article.

The trials were conducted in all the three groups of rice which are termed Aman, Aus and Boro according to the seasons in which the crop is raised.

1. Aman (winter) rice, represents 70% of the rice crop of East Pakistan.

(a) Transplanted *aman* is grown on medium lands where water-movement can be controlled by bunds around the fields. Seedlings are raised in nursery beds during the months of June-July and transplanted to puddled fields in the rainy months of August and September. Harvesting begins in the later part of November and continues until the end of December.

(b) Broadcast *aman* is grown in low-lying areas where during monsoon, water stands to a depth of more than 3-4 feet and the level of water may go upto 10-12 feet. There is no way of controlling the movement of water over these

fields. Seeds are sown broadcast before the floods during the months of April and May. Harvesting period is the same as that of transplanted *aman*.

2. Aus (autumn) crop represents 27% of the rice crop. It is usually sown broadcast in the months of April and May, and harvested in the months of July and August.

3. Boro (spring) crop represents only about 3% of all rice grown. This crop is grown in very lowlying areas, where even broadcast *aman* rice cannot be grown. Transplanting begins in November and may continue upto February depending upon the time when water recedes from these areas. Harvesting is done during April and May. This is the only crop which receives occasional irrigation.

Soils of the Experimental Areas

1. Brahmaputra alluvium represents the most fertile soils of East Pakistan, formed under the influence of the river Brahmaputra and its many tributaries. The soil is rich and the fertility is replenished by fresh deposits of silts carried down by flood waters. The pH varies from 5.5 to 6.8.

2. Gangetic alluvium represents riverine lands of the Gangetic plains. The soil is characterised

¹ Agricultural Chemist, East Pakistan.

by a high lime content. The texture varies from clay loam to sandy loam. The pH varies from 7 to 8.5.

3. Tista silt soils are sandy loam soils, the pH ranges from 6 to 6.8.

4. Madhupur tract soils are representative of red lateritic soils in a high land tract above flood level intersected by numerous local depressions which are highly valued for *aman* rice. The soils are clayey containing ferruginous concretions. They are deficient in organic matter, phosphorus and lime. The pH is between 5.5 and 6.5.

5. Barind tract belongs to an old alluvial formation which is usually composed of massive argillaceous beds of pale reddish brown colour. Pisolitic ferruginous concretions occur throughout the mass. The pH varies from 6 to 6.5.

6. Coastal saline soils represent a flat lowlying area and old and new islands. In the south near the sea are the "sundarbans" a region of morasses and swampy islands, most of which are covered with dense evergreen forest, while some are covered with salt water of the tidal floods. The soil is saline and salt efflorescences occur in many places.

7. Hilly soils in Chittagong Hill Tracts, mostly under forest and "shifting cultivation" on the hill slopes.

Experiments

The number of experiments on each of the rice crops and the sequence of fertilizer treatments are shown in Table 1. The number of experiments per crop was increased as the field staff gained experience.

Fifty well distributed centres were used on six soil tracts of East Pakistan. One field assistant was in charge of each centre. One Chemical Assistant supervised the work of 6-7 centres. Ten-15 experiments were conducted on each crop per centre of 5 miles radius. The results of each centre are expressed by the averages of each of the treatments.

The size of the plots varied from 1/10th to 1/40th of an acre because of the farmer's small holdings but plots of 0.1 acre size were chosen wherever feasible. In practice the majority of the plots were between 1/11th to 1/20th of acre.

Fertilizer was applied to the *aus* crop by broadcasting at the time of sowing. It was then ploughed in and the field was levelled by laddering. For transplanted *aman* and *boro* crops, fertilizers were applied at the time of puddling the field for seedling transplantation.

TABLE 1
Sequence of Fertilizer Treatments on Rice.

Sl. No.	Crops	No. of Expt.	Treatments							Remarks
			1	2	3	4	5	6	7	
1	Aman	1957	116							Aman '57 and Aus '58 crops were severely affected by drought.
2	Boro	1958	33	Control	20* N	40 N	40 P	40(N+P)	20N+20N ^x	
3	Aus	1958	378						40 P	
4	Aman	1958	380							Aman's 58 crop was severely affected by drought.
5	Boro	1959	131	Control	40 N	40 P	40 K	40(N+P)	40(N+P+K)	
6	Aus	1959	431							
7	Aman	1959	453	Control	40 N	40 P	40 K	40(N+P)	40(N+P+K)	Favourable weather prevailed.
8	Boro	1960	150	Control						— do —
9	Aus	1960	641		40 N	40 N'	40(N+P)	40(N'+P)	40(N+P+K)	
									40(N'+P+K)	
10	Aman	1960	658	Control	40(N+P)	40(N'+P)	40(N'+P')	40(N+P+K)	40(N'+P+K)	Crops suffered from excessive rain, cyclone and flood at the early stage and drought at the later stage.

N — Nitrogen from ammonium sulphate

N^x — "

N' — "

P — P₂O₅

P' — "

K — K₂O

cowdung

urea

treble superphosphate

bonemeal

muriate of potash

* Numerical figures in the treatments indicate lb. of nutrients per acre.

Results

The data in Table 2 represents the condensed results of more than 3,000 experiments. The treatment effects of all the experiments on a particular crop (*aus*, *aman* and *boro*) over the whole of the Province are averaged. The average yields of *aus*, *aman* and *boro* crops obtained in the different treatments for the year 1959 are shown graphically in figure 1 to indicate the extent of response of fertilizer treatments on different rice crops.

The control average yields of *aus*, *aman* and *boro* rice under the experiments were 15.4, 17.5 and 19.0 mds.* respectively. Nitrogen alone at the rate of 40 lbs. per acre increased the yields of *aus*, *aman* and *boro* by 37, 40 and 46% respectively. The effects of 20 lbs. and 40 lbs. of nitrogen per acre were compared on *aman* '57, *aus* '58 and *boro* '58 and the relative rating with the control as 100 is as follows:—

		20 N	40 N
Aman	1957	128	143
Boro	1958	123	149
Aus	1958	120	137

The yield increase due to 40 N was nearly double that of 20 N and therefore in the subsequent experiments the dose of nitrogen was fixed at 40 kgs. N per ha. though yet it remains to be seen if the rate of nitrogen can profitably be increased above 40 N.

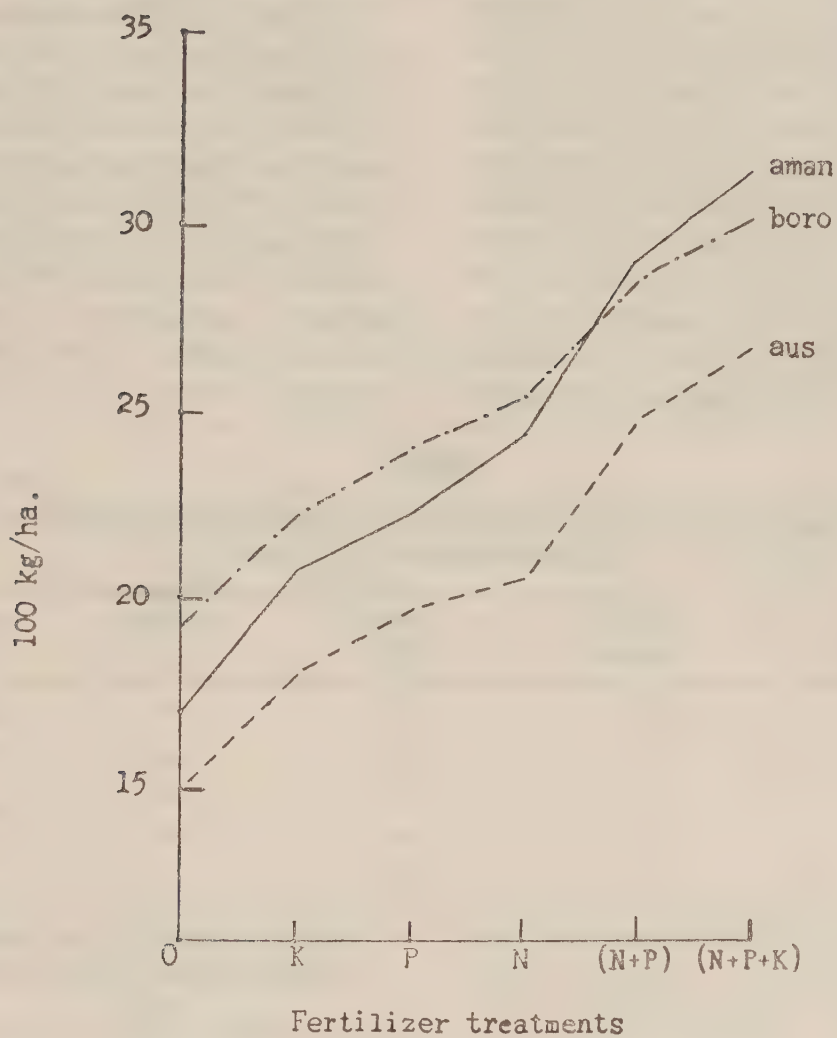
The effect of phosphorus is in-between those of nitrogen and potassium. The response of potassium is not as uniform over all the centres as those of nitrogen and phosphorus. It seems to give response in certain soil types to be described later.

The applications of mixed fertilizers gave much higher yields than single fertilizers, the efficiency of N P K being higher than that of N P. The average of 3 years on *aus* and *boro* and 4 years on *aman* indicated that the yields of *aus*, *aman* and *boro* can be increased by 64, 57, 50% respectively by N P fertilizer and by 92, 78 and 62% respectively by N P K fertilizers, although with favourable climate the yield increase can be much more. This is evident from the data of 1959 when N P and N P K fertilizers increased the yield of *aus*, *aman* and *boro* by 69 and 72, 49 and 83, 86 and 57% respectively.

* 1 maund = 37.3 kg.

FIGURE 1

Average yields of *aus*, *aman* and *boro* rice due to
fertilizer treatments



Comparative Efficiency of Urea and Ammonium Sulphate as Nitrogenous Fertilizer for Paddy

In order to compare the efficiency of urea with that of ammonium sulphate as nitrogen fertilizer, 432 experiments were conducted on *aman* rice of 1959. Also, 150 experiments with *boro* rice and 641 experiments on *aus* rice were conducted in 1960 with urea and ammonium sulphate singly and in combination with phosphatic and potassic fertilizers. Another 628 experiments were conducted on *aman* rice in 1960 to compare urea and ammonium sulphate in combination with two kinds of P_2O_5 carrier e.g. bonemeal and treble superphosphate and also in

combination with phosphatic and potassic fertilizers. The average percentage increases of the yield due to these treatments over the entire province as a whole (shown in Table 3) indicate that urea is better than ammonium sulphate as nitrogen fertilizer for paddy.

But the variations of average yields from centre to centre are so great that the superiority of urea over ammonium sulphate is not statistically significant when all the data of the province are put together. If the data are studied on a centre basis, some of the centres show consistently better results with urea, and the centres can be grouped in each of the rice lands according to their response to urea.

TABLE 3

Comparative efficiency of urea and ammonium sulphate expressed as percentage increase over control.

Treatments	(1959) Aman	(1960) Boro	(1960) Aus	(1960) Aman
N	43	35	35	—
N'	46	38	39	—
NP	71	49	59	44
N'P		55	67	50
N'P'	—	—	—	49
NPK	85	71	82	68
N'PK		69	83	77
N'P'K'	—	—	—	72

N — Nitrogen from ammonium sulphate
P — P_2O_5 „ treble superphosphate
K — K_2O „ muriate of potash
N' — Nitrogen „ urea
P' — P_2O_5 „ bonemeal

For a given crop in a given centre, urea was rated as better than ammonium sulphate when urea gave an increase of not less than 184 kgs. per ha. over ammonium sulphate. In the case of *aman* (1960) urea was regarded to be better than ammonium sulphate when it gave higher yields in treatments 3 and 6 over 2 and 5. Where the yield difference between the two fertilizers were negligible or not uniform in different combinations, urea was not regarded as superior to ammonium sulphate. Taking all the crops together, urea was rated as superior in a centre where at

least 2 out of 3 crops showed better response. Similar criteria were used to decide the superiority of ammonium sulphate.

From the grouping (Table 4) we see that in 20 centres urea was better than ammonium sulphate and in 22 centres urea was almost equal to ammonium sulphate. In four centres only ammonium sulphate proved better than urea. The cause of better responses of urea is yet to be established with respect to soil properties by soil analysis but tentatively it appears that urea is superior in sandy and acidic soils of tista silt and Brahmaputra alluvium.

TABLE 4

Indicating the number of centres in the different soils where either urea or ammonium sulphate were found to be equal or better.

Comparison	Soils of the experimental area						Total
	Brahmaputra alluvium	Gangetic alluvium	Tista Silt	Red	Barind	Coastal Saline	
Urea better	8	3	4	2	2	1	20
Urea = ammonium sulphate	10	3	2	1	3	3	22
Ammonium sulphate better	1	2	—	—	—	1	4

Comparative Efficiency of Treble Superphosphate and Bonemeal

Efficiency of treble superphosphate and bonemeal was compared on the *aman* crop of 1960, in combination with urea and again with urea and muriate of potash. Treble superphosphate was regarded as better than bonemeal when it gave sufficiently higher yield in both the combinations in a particular centre. Where the

yield differences between the two fertilizers were negligible or not uniform in 2 different combinations, treble superphosphate was not regarded as superior to bonemeal. Thus, it was found that in a large number of centres (18) treble superphosphate gave better results than bonemeal. In 15 centres the differences are negligible, and as such there is no choice between superphosphate and bonemeal for these centres. In 13 centres out

of 46 only was bonemeal better than superphosphate. The data shows that most of the centres favourable to bonemeal are located in Tista Silt and Red Soil Tracts, indicating that bonemeal is more efficient in sandy soils and old alluvial red laterite soils.

Effect of Potassium

Experiments with potassium on paddy were started from *aman* crop of 1958 and since then 2744 experiments have been conducted with potassium supplied in the form of muriate of potash, both singly and in combination with nitrogenous and phosphatic fertilizers. Significant yield increases were obtained on all crops in every season, though as a single fertilizer its response was not as great and as frequent as with nitrogen and phosphorus. In combination with nitrogen and phosphorus, however, the potassium response has been more uniform and promising than when applied alone.

On the basis of experiments with potassium for 3 years the centres have, tentatively, been grouped into 3 categories such as "Responsive to potassium", "negligible response to potassium" and "negative response to potassium" as shown in table 5. When applied alone a centre was taken as responsive to potassium if the yield increase was not less than 2 mds. of paddy. In mixed applications, the effect of potassium was determined by subtracting the yield with nitrogen-phosphate from that with nitrogen-phosphate-potash. In the case of *aman* (1960) a centre was regarded as responsive to potassium when its effect was higher in all the 3 combinations containing potassium. When the effect of potassium was negligible or did not appear in all the combinations, the centre was regarded as giving negligible response to potassium. In a few cases, potassium did not increase the yield at all, rather it depressed the yield. Such centres are regarded as giving a negative response to potassium.

TABLE 5

A listing of the number of centres showing degrees of response to potassium in six different soils.

Response to K	Soils of Experimental area					
	Brahmaputra Alluvium	Gangetic Alluvium	Tista Silt	Red	Barind	Coastal Saline
Positive	14	1	7	2	4	2
Negligible	8	8		1	3	7
Negative	1	1			1	

From the distribution of centres, it is seen that all the centres under Tista silt tract, and the most of the centres in Brahmaputra alluvium and only a few centres in Barind and Red soil

tracts responded to potassium. In the centres in Gangetic alluvium and saline tracts, the response was a negligible. The cause of the negative response in 3 centres is not understood,

Economics of Fertilizer Application

In the previous paragraphs, response of different fertilizer combinations on rice at different centres have been indicated. But the actual application and choice of a particular fertilizer combination will be determined by economic consideration.

One way of examining the economics of manuring is to determine the profit in rupees by subtracting the cost of fertilizer from the price of the increased yield of paddy over control. But this figure does not give information about profit in relation to capital investment. The ratio of the price of increased yield to the cost of fertilizer gives further critical information about the economics of manuring.

Examining profit by ratio, a ratio of 2 or more has been taken to mean definite profit and sufficient incentive for fertilizer application. Although a ratio of greater than one indicates profit, it is preferable to recommend fertilizer application in such cases where a ratio of 2 or more has been attained. This is necessary to cover the cost of additional labor, interest on fertilizer loan and also to ensure a reasonable profit.

Economics of fertilizer application for paddy in East Pakistan has been examined both by profit in rupees and price-cost ratio. Government controlled rate of paddy and unsubsidized rate of fertilizers

have been used in this study. The profit becomes more encouraging for cultivators, when the government subsidy on fertilizer is considered. Since experiments on *Aman* (1960) were conducted with 2 kinds of nitrogen and 2 kinds of P_2O_5 carriers the economics of fertilizer application has been studied for each centre with different fertilizer combinations. By this study it has been possible to group centres according to the most favourable fertilizer combination as given in the following table.

*Combinations found profitable
in different centres*

<u>Combination</u>	<u>Centres</u>
Urea + super + potash	19
Urea + bonemeal + potash	10
Urea + super	5
Ammonium sulphate + super	5
Ammonium sulphate + super + potash	2
Urea + bonemeal	1

Among different combinations of nitrogen, phosphorus and potassium, the combination of urea, superphosphate and potash has been recommended in a maximum number of cases, followed by urea, bonemeal and potash. These economic studies very much favour the use of urea and treble superphosphate as preferred carriers of nitrogen and phosphorus for paddy in East Pakistan.

THE SEVENTH SESSION OF THE INTERNATIONAL RICE COMMISSION

The Seventh Session of the International Rice Commission was held in Saigon, Vietnam, 16-20 November 1960, through the kind invitation of the Government of Vietnam. The Session was attended by 50 participants representing 18 countries and two observers, one each from Republic of Madagascar and Mali and the Director, International Rice Research Institute, Philippines.

Progress Report by the Executive-Secretary of the Commission

Dr. N. Parthasarathy, who has served as Executive-Secretary of the International Rice Commission since January, 1959, referred to the work of his predecessor, Mr. C.W. Chang who relinquished the position due to the pressure of other work.

The Secretary then reported on activities of the Commission since the Sixth Session held in Tokyo in 1958, expressing satisfaction at the establishment of the International Rice Research Institute at Los Banos, The Philippines, which will fulfill a long-felt need of member governments of the Commission.

He then referred to the 8th Meeting of the Working Party on Rice Production and Protection and the 7th Meeting of the Working Party on Rice Soils, Water and Fertilizer Practices which were held concurrently at Peradeniya, Ceylon, in 1959, and to the First Meeting of the Working Party on Agricultural Engineering Aspects of Rice Production, Storage and Processing which had been held immediately preceding the 7th Session of the Commission at Saigon.

Reference was also made to the appointment of 3 new Regional Advisors to the Far East Regional Office at Bangkok on Irrigation Agronomy, Agricultural Engineering and Farm Management.

It was noted that three Regional Farm Management Development Centers had been held:— one in Saigon, Vietnam, in 1958; one in Bangkok, Thailand in 1959, and the third in Manila, and Los Banos, Baguio, the Philippines during 1960.

The FAO World Catalogue of Genetic Stocks of Rice-Supplement No. 7 had been published, as well as two Working Bulletins, e.g. No. 2 on "Equipment for Rice Production under Wet Paddy Conditions" and No. 15 on "Methods and Equipment for Rice Testing". The IRC Newsletter had entered its 9th year of publication and its circulation had greatly increased.

With the help of Member Countries, FAO is preparing a list of important improved rice varieties adaptable to a wide range of climatic and soil conditions which will be circulated to all countries concerned.

The Regional Rice Improvement Specialist had paid a visit to West African Countries; a full report on this visit would be submitted to FAO.

The Executive-Secretary also mentioned recommendations made by the FAO Group of Experts on Grading and Standardization of Rice at the February 1960 Session of the CCP Consultative Sub-Committee on Economic Aspects of Rice. He indicated that while some of these recommendations have already been

discussed in the relevant Working Parties of the IRC, further consideration will be given to them at future meetings of the Working Parties concerned.

Summary of Recommendations

The Commission, having considered the various items on the Agenda of the Seventh Session,

- (a) commended the Working Parties on Rice Production and Protection; Rice Soils, Water and Fertilizer Practices; Agricultural Engineering Aspects of Rice Production, Storage and Processing, for the good work they had performed,
- (b) generally approved the recommendations put forward by these Working Parties,
- (c) considered the specific action that should be taken to further the work in various fields.

The Commission recommended the following items under five headings:

Rice Production and Protection

1. Greater attention be paid to the development of basic research in planning of future research activities.

2. In countries having significant areas in upland rice, steps be taken to study the various technical aspects of increasing production of rice grown under this system of cultivation.

3. FAO should provide appropriate assistance to Member Countries of the tropical region for the framing of suitable legislative measures to prevent and control the indiscriminate use of dangerous agrochemicals,

4. Where appropriate, due consideration be paid to the setting up of National Rice Committees in Member Countries which have not established the same so far.

Rice Soils, Water and Fertilizer Practices

5. FAO should continue the activities indicated by the Working Party on Rice Soils, Water and Fertilizer Practices in view of the need for effective means of facilitating exchange of information and developing cooperation among countries.

6. As it may not be always practicable to depute a number of specialists to represent different disciplines to be discussed in working party meetings, FAO should circulate the agenda of these meetings as much in advance as possible, so that the limited number of delegates who would attend may be properly briefed. It would be helpful if one item on the agenda were given special consideration in a particular working party meeting so that the appropriate specialist concerned may be deputed by each member country.

7. Countries be encouraged to develop land type mapping as a basis for research planning.

Agricultural Engineering Aspects of Rice Production, Storage and Processing

8. FAO should assist Member Governments within the International Rice Commission in establishing a program for:

- (a) the exchange of tools and equipment for rice production, with the aim of fostering demonstrations and testing;

- (b) the introduction and adaptation of improved tools and equipment;

9. Funds be made available for such a program from the Freedom-From-Hunger Campaign.

10. Member Governments be requested to give particular attention to experimental studies, trials, development and improvement of farm implements for rice production, hand, animal, and power operated. To this end national testing and research centers should be strengthened or established.

11. Ways and means be found to enable the Agricultural Engineering Branch to obtain greater facilities for the exchange of technical information on agricultural engineering aspects of rice production, storage and processing to Member Governments.

12. FAO should assist Member Governments in obtaining agricultural tools and machines at minimum cost, and to

eliminate foreign exchange difficulties where they arise. It was suggested that Freedom-From-Hunger Campaign funds might be used for this purpose.

The Possible Relationship of the Commission with the International Rice Research Institute, Los Banos, The Philippines

13. That the possible relationship be expressed in general terms so that the Director-General of FAO and the Board of Trustees of the International Rice Research Institute would be free to give the matter further study.

Discussion of Long Term Programs of the International Rice Commission

A number of suggestions were offered, illustrative of projects deserving long-term programming by the International Rice Commission in 1962. It was hoped that a new long-term program of research and development would be evolved for submission to the Eighth Session of the IRC in 1962.

THE 1961 MEETINGS OF TWO WORKING PARTIES ON RICE
PRODUCTION AND PROTECTION; AND RICE SOILS, WATER
AND FERTILIZER PRACTICES OF THE INTERNATIONAL
RICE COMMISSION TO BE HELD IN
NEW DELHI, INDIA

11-16 December 1961

At the kind invitation of the Government of India, the Ninth Meeting of the Working Party on Rice Production and Protection and the Eighth Meeting of the Working Party on Rice Soils, Water and Fertilizer Practices of the International Rice Commission will be held simultaneously from 11 to 16 December 1961, inclusive at New Delhi, India. The Director-General of the Food and Agriculture Organization of the United Nations has issued invitations to all member governments of the Commission to send highly-qualified scientists to attend these meetings.

The Provisional Agenda of these two Working Parties Meetings are given below :

Provisional Agenda

(For the Ninth Meeting of the Working Party on Rice Production and Protection).

Procedural Matters

1. Opening of the Session, jointly with the Session of the Working Party on Rice Soils, Water and Fertilizer Practices
2. Election of Chairman and Vice-Chairmen
3. Adoption of Agenda
4. Election of Drafting Committee

Matters Relating to Rice Production and Protection

- * 5. Variety-Fertilizer Interaction
- * 6. Irrigation Agronomy in Rotation with Rice
7. Reduction in the Number of Rice Varieties, and Breeding of Varieties with Wide Adaptability
8. Progress in Breeding for Resistance to Blast and Other Diseases
9. Varietal Resistance to the Gall Midge, *Pachytiplosis oryzae*, and other Insect Pests of Paddy
10. Use of Irradiation in Rice Breeding
11. Large-scale Distribution of Recommended Varieties to Farmers
12. Cooperative Tests with Insecticides to Evaluate Crop Losses caused by Insects
13. New Pesticides for Control of Insects, Diseases, Weeds and Other Pests of Paddy
14. Standardization of Methods for the Determination and Expression of Losses in Storage
15. Outstanding Problems in the Protection of Paddy and Milled Rice, including Parboiled Rice,

* Jointly with the Working Party on Rice Soils, Water and Fertilizer Practices

Stored on Commercial Scale for Short or Long Periods, and of Paddy in Rural Storage

(a) Fumigation and other Chemical Methods of Insect Control in Storage

(b) Rodent Control Programs and Problems

(c) Problems in Drying, Aeration, and Other Practices Necessary for the Prevention of Spoilage and Losses in Quality During Storage

16. Relationship between Temperature and Degree of Infestation in Stored Rice

17. Effects of Various Storage Practices and Treatments on the Cooking Qualities, Acceptability and Nutritive Value of Rice

18. Training Facilities and Programs for Storage Personnel

Procedural Matters

19. Other Business

20. Time and Place of Next Meeting

21. Adoption of Report

Provisional Agenda

(For the Eighth Meeting of the Working Party on Rice Soils, Water and Fertilizer Practices)

Procedural Matters

1. Opening ceremonies (jointly with the Working Party on Rice Pro-

duction and Protection)

2. Election of Chairman and Vice-Chairmen

3. Adoption of Agenda

4. Election of the Drafting Committee

5. Critical examination of the responses to N, P, K and lime fertilizers

6. The Working Party's long-term program of work

* 7. Variety-Fertilizer interaction

* 8. Irrigation agronomy in rotation with rice

9. Nitrogen, phosphorus and potassium carriers and liming materials

(a) efficacy of the different fertilizer materials

(b) time and methods of application

10. Soil analysis and foliar diagnosis

11. Preliminary Report of the Survey of the Fertilizer Economy of the Asia and Far East Region

12. Subject to be selected for particular attention of the Working Party at its meeting in 1963

13. Other business

14. Time and place of next meeting

15. Consideration of draft report

* Jointly with the Working Party on Rice Production and Protection.

